

U.S. Patent Application Serial No. 10/665,259
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

AMENDMENTS TO THE CLAIMS:

Please amend claims 1, 17, 19 and 31, as follows. This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Currently amended): A semiconductor light-receiving device comprising:

- a substrate that has a first surface and a second surface ~~facing~~ opposite to each other;
- a first semiconductor layer that is formed ~~on~~ above the first surface of the substrate and includes at least one semiconductor layer portion of a first conductivity type;
- a light absorption layer that is formed ~~on~~ above the first semiconductor layer and generates carriers in accordance with incident light;
- a second semiconductor layer that is formed ~~on~~ above the light absorption layer and includes at least one semiconductor layer portion of a second conductivity type;
- a first electrode part that is electrically connected to the first semiconductor layer and applies a first potential thereto;
- a second electrode part that is electrically connected to the second semiconductor layer and applies a second potential thereto; ~~and~~
- a third semiconductor layer of the second conductivity type ~~that is interposed between the first surface of~~ provided so that the substrate, the third semiconductor layer and the first semiconductor layer are arranged in this order; and

U.S. Patent Application Serial No. 10/665,259
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

a third electrode part that is electrically connected to the substrate and applies a third potential thereto.

the first potential being higher than the third potential.

Claim 2 (Original): The semiconductor light-receiving device as claimed in claim 1, further comprising a capacitor that includes a p-n junction between the first semiconductor layer and the third semiconductor layer.

Claim 3 (Original): The semiconductor light-receiving device as claimed in claim 2, wherein the capacitor has a depletion-layer region that is formed at the p-n junction between the first semiconductor layer and the third semiconductor layer.

Claim 4 (Original): The semiconductor light-receiving device as claimed in claim 1, further comprising

a fourth semiconductor layer of the first conductivity type,

wherein the third semiconductor layer is interposed between the first semiconductor layer and the fourth semiconductor layer.

Claim 5 (Original): The semiconductor light-receiving device as claimed in claim 2, wherein the capacitor functions as a bypass capacitor that bypasses current flowing between the first

U.S. Patent Application Serial No. **10/665,259**
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

semiconductor layer and the second semiconductor layer when carriers are generated in the light absorption layer.

Claim 6 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the first semiconductor layer includes a contact layer that is connected to the first electrode part and has a relatively high impurity concentration.

Claim 7 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the second semiconductor layer includes a contact layer that is connected to the second electrode part and has a relatively high impurity concentration.

Claim 8 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the first semiconductor layer includes a buffer layer having a relatively low impurity concentration.

Claim 9 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the second semiconductor layer includes a graded layer in which a plurality of semiconductor layers are stacked so that forbidden bandwidths vary smoothly.

Claim 10 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein:

U.S. Patent Application Serial No. **10/665,259**
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

at least the light absorption layer and the second semiconductor layer form a mesa structure; and
light enters through a side surface of the light absorption layer that is exposed in the mesa structure.

Claim 11 (Original): The semiconductor light-receiving device as claimed in claim 10,
further comprising an optical waveguide path that is provided on a side of the mesa structure and
guides light into the light absorption layer.

Claim 12 (Original): The semiconductor light-receiving device as claimed in claim 10,
wherein:

the first semiconductor layer has a surface exposed at the bottom of the mesa structure;
the first electrode part is formed on the exposed surface; and
the second electrode part is formed on the second semiconductor layer of the mesa structure.

Claim 13 (Original): The semiconductor light-receiving device as claimed in claim 1,
comprising an avalanche diode.

Claim 14 (Original): The semiconductor light-receiving device as claimed in claim 1,
wherein:

the first semiconductor layer includes an n-type InP layer; and
the second semiconductor layer includes a p-type InP layer.

U.S. Patent Application Serial No. 10/665,259
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

Claim 15 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the light absorption layer is an InGaAs layer.

Claim 16 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the third semiconductor layer is a p-type InP layer and has an impurity concentration of $1 \times 10^{16} \text{ cm}^{-3}$ or lower.

Claim 17 (Currently amended): A semiconductor light-receiving device comprising:

- a semiconductor substrate that has a first surface and a second surface facing opposite to each other;
- a first semiconductor layer that is formed ~~on~~ above the first surface of the semiconductor substrate and includes at least one semiconductor layer portion of a first conductivity type;
- a light absorption layer that is formed ~~on~~ above the first semiconductor layer and generates carriers in accordance with incident light;
- a second semiconductor layer that is formed ~~on~~ above the light absorption layer and includes at least one semiconductor layer portion of a second conductivity type;
- a first electrode part that is electrically connected to the first semiconductor layer and applies a first potential thereto;
- a second electrode part that is electrically connected to the second semiconductor layer and

U.S. Patent Application Serial No. 10/665,259
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

applies a second potential thereto; and

a capacitive element that comprises a dielectric material ~~interposed between~~ provided so that
the first surface of the semiconductor substrate, the dielectric material and the first semiconductor
layer are arranged in this order.

Claim 18 (Original): The semiconductor light-receiving device as claimed in claim 17,
wherein the capacitive element includes a high-resistance semiconductor layer that is interposed
between a pair of semiconductor layers of the first conductivity type.

Claim 19 (Currently amended): The semiconductor light-receiving device as claimed in
claim 5 ~~17~~, wherein ~~the same~~ a third potential as equal to the second potential is supplied to the
second surface of the substrate.

Claim 20 (Original): The semiconductor light-receiving device as claimed in claim 17,
wherein the first semiconductor layer includes a contact layer that is connected to the first electrode
part and has a relatively high impurity concentration.

Claim 21 (Original): The semiconductor light-receiving device as claimed in claim 17,
wherein the second semiconductor layer includes a contact layer that is connected to the second
electrode part and has a relatively high impurity concentration.

U.S. Patent Application Serial No. 10/665,259
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

Claim 22 (Original): The semiconductor light-receiving device as claimed in claim 17, wherein the first semiconductor layer includes a buffer layer having a relatively low impurity concentration.

Claim 23 (Original): The semiconductor light-receiving device as claimed in claim 17, wherein the second semiconductor layer includes a graded layer in which a plurality of semiconductor layers are stacked so that forbidden bandwidths vary smoothly.

Claim 24 (Original): The semiconductor light-receiving device as claimed in claim 17, wherein:

at least the light absorption layer and the second semiconductor layer form a mesa structure;

and

light enters through a side surface of the light absorption layer that is exposed in the mesa structure.

Claim 25 (Original): The semiconductor light-receiving device as claimed in claim 24, further comprising an optical waveguide path that is provided on a side of the mesa structure and guides light into the light absorption layer.

U.S. Patent Application Serial No. **10/665,259**
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

Claim 26 (Original): The semiconductor light-receiving device as claimed in claim 24,
wherein:

the first semiconductor layer has a surface exposed at the bottom of the mesa structure;
the first electrode part is formed on the exposed surface; and
the second electrode part is formed on the second semiconductor layer of the mesa structure.

Claim 27 (Original): The semiconductor light-receiving device as claimed in claim 17,
comprising an avalanche diode.

Claim 28 (Original): The semiconductor light-receiving device as claimed in claim 17,
wherein:

the first semiconductor layer includes an n-type InP layer; and
the second semiconductor layer includes a p-type InP layer.

Claim 29 (Original): The semiconductor light-receiving device as claimed in claim 17,
wherein the light absorption layer is an InGaAs layer.

Claim 30 (Original): The semiconductor light-receiving device as claimed in claim 17,
wherein the capacitive element functions as a bypass capacitor that bypasses current flowing between

U.S. Patent Application Serial No. 10/665,259

Amendment filed March 15, 2006

Reply to OA dated November 25, 2005

the first semiconductor layer and the second semiconductor layer when carriers are generated in the light absorption layer.

Claim 31 (Currently amended): A semiconductor light-receiving device comprising:

- a substrate that has a first surface and a second surface facing opposite to each other;
- a first semiconductor layer that is formed on above the first surface of the substrate and includes at least one semiconductor layer portion of a first conductivity type;
- a light absorption layer that is formed on above the first semiconductor layer and generates carriers in accordance with incident light;
- a second semiconductor layer that is formed on above the light absorption layer and includes at least one semiconductor layer portion of a second conductivity type;
- a first electrode part that applies a first potential to the first semiconductor layer, wherein the first potential is higher than the reference potential;
- a second electrode part that applies a second potential to the second semiconductor layer;
- a metal layer that is formed on the second surface of the substrate and has a reference potential supplied thereto; and
- a dielectric layer ~~that is interposed between~~ provided so that the metal layer, the dielectric layer and the second surface of the substrate are arranged in this order,
- a capacitor including dielectric layer being formed in the semiconductor light-receiving device.

U.S. Patent Application Serial No. **10/665,259**
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

Claim 32 (Original): The semiconductor light-receiving device as claimed in claim 31, comprising a module onto which the substrate is mounted, wherein the metal layer is electrically connected to the module and is supplied with the reference potential.

Claim 33 (Original): The semiconductor light-receiving device as claimed in claim 31, wherein the first semiconductor layer includes a contact layer that is connected to the first electrode part and has a relatively high impurity concentration.

Claim 34 (Original): The semiconductor light-receiving device as claimed in claim 31, wherein the second semiconductor layer includes a contact layer that is connected to the second electrode part and has a relatively high impurity concentration.

Claim 35 (Original): The semiconductor light-receiving device as claimed in claim 31, wherein the first semiconductor layer includes a buffer layer having a relatively low impurity concentration.

Claim 36 (Original): The semiconductor light-receiving device as claimed in claim 31, wherein the second semiconductor layer includes a graded layer in which a plurality of semiconductor layers are stacked so that forbidden bandwidths vary smoothly.

U.S. Patent Application Serial No. **10/665,259**
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

Claim 37 (Original): The semiconductor light-receiving device as claimed in claim 31,
wherein:

at least the light absorption layer and the second semiconductor layer form a mesa structure;
and
light enters through a side surface of the light absorption layer that is exposed in the mesa structure.

Claim 38 (Original): The semiconductor light-receiving device as claimed in claim 37,
further comprising an optical waveguide path that is provided on a side of the mesa structure and
guides light into the light absorption layer.

Claim 39 (Original): The semiconductor light-receiving device as claimed in claim 37,
wherein:

the first semiconductor layer has a surface exposed at the bottom of the mesa structure;
the first electrode part is formed on the exposed surface; and
the second electrode part is formed on the second semiconductor layer of the mesa structure.

Claim 40 (Original): The semiconductor light-receiving device as claimed in claim 31,
comprising an avalanche diode.

U.S. Patent Application Serial No. **10/665,259**
Amendment filed March 15, 2006
Reply to OA dated November 25, 2005

Claim 41 (Original): The semiconductor light-receiving device as claimed in claim 31,
wherein:

the first semiconductor layer includes an n-type InP layer; and

the second semiconductor layer includes a p-type InP layer.

Claim 42 (Original): The semiconductor light-receiving device as claimed in claim 31,
wherein the light absorption layer is an InGaAs layer.